

## CPSC 1155 – Lab 4

### Selection Statements / Random Numbers

#### Learning Objectives

At the end of this lab, you should be able to:

- Understand and analyze a selection statement
- Write a pseudocode with selection statements to solve a problem
- Write and run a C++ program with selection statements to solve a problem
- Generate random values in a C++ program

#### Lab Introduction

This lab focuses on learning selection statements. You will also learn how to generate random numbers in C++.

#### Lab Readings

1. Pseudocode Lecture
2. Chapter 3 – Selection

#### Lab Instructions

Write your answers to the **Practice Questions** in a text editor (answer.txt). You need to write C++ programs for questions 2, 4, and 5 in .cpp files as instructed.

Submit according to the instructions in the "Lab Submission" section.

#### Practice Questions

1. [5] **Predict the Printout.** The following C++ program is given. Write your calculations to evaluate each expression. Write the printout of the program.

```
int i = 1, j = 2, k = 5;
cout << "1: " << (k < i - j) << endl;
cout << "2: " << (++i == j) << endl;
cout << "3: " << ((k - i-- > j) && (k == j * 2)) << endl;
cout << "4: " << (!(k > j) || (i == k % j)) << endl;
cout << "5: " << (((k - i) && (j > 2)) || !i) << endl;
```

2. [6] **Troubleshooting.** A bakery is holding a pie sale once a month. All pies with a regular price of more than \$10 are \$3.14 off. All others are \$1.00 off. The following solution is proposed, but it has a fault. Write at least three test cases (typical input values), one for each if statement and one for an invalid input, and check if the result is correct or not. Write your answers in a tabular form as shown in answer.txt. Write the correct C++ program to solve the problem and save it as pieSale.cpp.

```
cin >> price;
if (price > 10){
    price = price - 3.14;
}
if (price < 10){
```

```

    price = price - 1;
}
cout << "Discounted price: " << price << endl;

```

Input value	Expected output	Comment

3. [4] **Reorder a Program.** Suppose you want to place two photos on a page, either next to each other or above each other. Pick and rearrange these lines of code to produce a program segment that determines if such an arrangement is possible. Not all lines are useful, so only pick the lines that you think are necessary. Write the correct order of statements by writing the line numbers as your answer in answer.txt.

Line #	Statement
1	if (width1 + width2 <= page_width    height1 <= page_height && height2 <= page_height)
2	if (width1 + width2 <= page_width && height1 <= page_height && height2 <= page_height)
3	if (width1 + width2 <= page_width    height1 <= page_height    height2 <= page_height)
4	else if (width1 <= page_width && width2 <= page_width && height1 + height2 <= page_height)
5	else if (width1 <= page_width    width2 <= page_width && height1 + height2 <= page_height)
6	else if (width1 <= page_width    width2 <= page_width    height1 + height2 <= page_height)
7	cout << "Place photos horizontally" << endl;
8	cout << "Photos don't fit" << endl;
9	cout << "Place photos vertically" << endl;
10	else

4. [5] **Random numbers.** (randomNumbers.cpp) The element of chance can be introduced into computer applications by generating a random number using the rand() function. This function is in <cstdlib> header file. You are going to write a C++ program and update it based on the following steps. You may write the answers to the questions as comments in your C++ program.
- Write a C++ program that generates and displays two random numbers. Remember to include <cstdlib> library. You may use the following statement to generate a random number:  

```
int i = rand();
```

What are the numbers that you get? Run the program a few times. Do the numbers change?
  - The rand() function returns a random number between 0 and RAND\_MAX. RAND\_MAX is a constant defined in <cstdlib> library (You do not need to declare it.).  

Write a statement that displays the value of RAND\_MAX in your program. What is this value?
  - You noticed that the random numbers generated by your program are not actually random!  

To randomize the numbers, we use time(0) function. This function returns the seconds elapsed since time 00:00:00 on January 1, 1970! You need to include <ctime> library.  

Write the following statement at the beginning of the main function to randomize the numbers:  

```
srand(time(0));
```

Note that this statement is written just once before using `rand()`.

Run your program a few times. What random numbers do you get? Write your numbers from two different runs.

- d. We can simulate the flip of a coin with two numbers; e.g.: 0 for Head and 1 for Tail.

In your program, use `rand()` function in an expression to generate a random number between 0 and 1. [Hint: Use % to limit the range of numbers to 0 to 1 instead of 0 to `RAND_MAX`.]. You still need to write `srand(time(0));`

- e. To simulate the throw of a dice, we need to generate random numbers from 1 to 6.

In your program, use `rand()` function in an expression to generate a random number between 1 and 6. You still need to write `srand(time(0));`

5. [10] **Compute Travel Time.** Write your answer for each step in `answer.txt`:

**Problem Statement** There are only two routes between two cities and the traveling time is different if it is rush hour or not. You are asked to display travel time between the two cities based on the following table:

Route/Hour	Rush hour	Regular hours
Normal route	60 min	40 min
Bay Bridge	45 min	30 min

**Step 1** Understand the problem: What are the inputs? What are the desired outputs? What are the constants? What are the conditions?

**Step 2** Work out examples by hand. Write all the possible valid input values and one invalid input value.

**Step 3** Declare the variables and constants that you need with meaningful names and correct data types.

**Step 4** Draw the simplest flowchart to solve the problem (See Lab Submission).

**Step 5** Write a pseudocode that reads the input values (clearly ask the user to input valid values), displays the results with informative messages, and displays a message for invalid input.

**Step 6** Turn the pseudocode into a C++ program (`travelTime.cpp`). Add comments where needed. Run and test your program with typical values.

### Lab Submission

Submit a zip folder named as `yourName_Lab4.zip` to Brightspace. This folder should consist of a text file named **answer.txt** with your answers to Practice Questions and three **C++ programs** (`pieSale.cpp`, `randomNumbers.cpp`, and `travelTime.cpp`). If you have your flowchart on paper, you may take a picture of it and include in the zip folder.

Please make sure that all your C++ programs compile and run properly before submission.

### Marking Scheme

The marks are given in square brackets [ ] for each question.